AN OVERVIEW OF NORMAL AND PATHOLOGICAL REFLEXES

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Reflexes are the body's intrinsic stimulus-response systems for maintaining homeostasis, and are often used for diagnosing and localizing nervous system disorders.

Reflexes may be divided into 4 groups:

1. Superficial reflexes
2. Deep reflexes
3. Visceral reflexes
4. Pathological reflexes

A *reflex arc* contains 2 or more neurons through which nervous impulses are transmitted from a receptor to the brain or spinal cord, and then to an effector. If the reflex arc is interrupted at any point, effector response is diminished or absent. The basic components of a reflex arc are illustrated in Figure 1.

SUPERFICIAL REFLEXES

Superficial reflexes are usually elicited by stroking the skin or mucous membranes.

A. Skin Reflexes

1. *Anal reflex*–Action: Stroke the perianal area or insert gloved finger into rectum. Response: Contraction of the sphincter ani.
2. *Cremasteric reflex*–Action: Stroke inner thigh. Response: Testicular elevation.
3. *Gluteal reflex*–Action: Stroke buttocks. Response: Contraction of buttocks.
4. *Interscapular reflex*–Action: Stroke skin of interscapular space. Response: Scapulas draw inward.
5. *Plantar reflex*–Action: Stroke sole of feet. Response: Plantar flexion of toes.
6. *Upper and lower abdominal reflexes*–Action: Medially stroke each side of abdomen above and below the umbilicus. Response: Umbilical deviation toward the stimulus.

B. Mucous Membrane Reflexes

1. *Corneal reflex*–Action: Touch cornea with wisp of cotton. Response: Blinking.
2. *Gag reflex*–Action: Irritate pharynx with tongue blade. Response: Gagging.
3. *Sneeze reflex*–Action: Irritate nasal membrane. Response: Sneezing.
4. *Uvular reflex*–Action: Phonation of "Ahh" or irritation of posterior third of tongue with tongue blade. Response: Uvular elevation.

C. Abnormal Reflex Responses

The combination of diminished or absent superficial reflexes with deep reflexes and pathological reflexes indicates upper motor neuron level (UMNL) involvement.

DEEP REFLEXES

Deep reflexes are elicited by a stretch stimulus applied to a muscle, and are graded from 0 to +4 (see Table 1).

1. *Achilles reflex*–Action: Strike achilles tendon. Response: Plantar flexion of foot.
2. *Biceps reflex*–Action: Strike biceps tendon. Response: Elbow flexion.
3. *Maxillary reflex*–Action: Striking middle of chin with mouth slightly open. Response: Sudden jaw closure.
4. *Patellar reflex*–Action: Strike patellar tendon. Response: Knee extension.
5. *Radial reflex*–Action: Strike radius above wrist.
6. *Triceps reflex*–Action: Strike triceps tendon. Response: Elbow extension.
7. *Ulnar reflex*–Action: Strike ulna above wrist. Response: Extension and ulnar deviation of wrist.

ABNORMAL DEEP REFLEXES

The diminution or absence of a deep reflex indicates any interruption of the reflex arc, such as an upper of lower motor neuron lesion (LMNL). The primary goal of evaluating deep reflexes is to determine if an UMNL or LMNL is present.

Hyperreflexia is consistent with an UMNL; conversely, hyporeflexia is consistent with a LMNL. Clonus or muscle rigidity (spastic paralysis) may be present with

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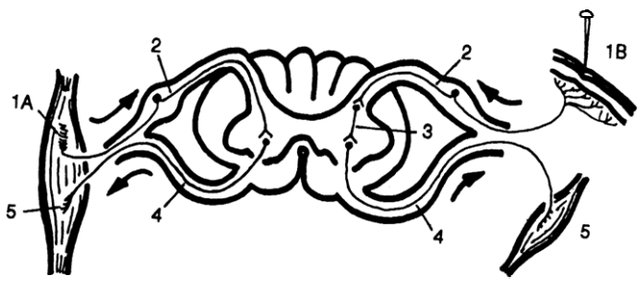

Figure 1. Reflex arc. Left side of diagram shows stretch reflex arc; right side shows flexor reflex arc. 1, Receptor. Initiates a nerve impulse after stimulation. A, Neuromuscular spindle. B, Skin or mucous membrane. 2, Afferent (sensory) neuron transmits nerve impulse from receptor through peripheral nerve to axonal termination in central nervous system. 3, Association (intercalated) neuron found in flexor reflex arc relays nerve impulse to efferent nerve. 4, Efferent (motor) neuron transmits nerve impulse to effector. 5, Effector. Muscle or gland that responds to the efferent impulse.

an UMNL, whereas flaccid paralysis may be present with a LMNL (see Table 2).

TABLE 2
UPPER VS LOWER MOTOR NEURON LESIONS

TEST	UMNL	LMNL
PARALYSIS	SPASTIC	FLACCID
DEEP REFLEXES	Y	N
CLONUS	Y	N
BABINSKI	Y	N
ATROPHY	Y/N	Y
FASCICULATION	N	Y

VISCERAL REFLEXES

A. Pupillary Reflexes

1. *Accommodation reflex*–Action: Patient looks at distant object, then near object. Response: Pupillary constriction and ocular convergence.
2. *Consensual light reflex*–Action: Shine light into opposite eye. Response: Pupillary constriction.
3. *Ciliospinal reflex*–Action: Pinch neck. Response: Pupillary dilation.
4. *Light reflex*–Action: Shine light onto retina. Response: Pupillary contraction.

B. Blink Reflex

Action: Unexpected, abrupt movement of object toward eyes. Response: Blinking or eyelid closure.

C. Oculocardiac Reflex

Action: Pressure directly over closed eyes. Response: Slowing of heart rate.

TABLE 1
DEEP REFLEX GRADING

GRADE	EXPLANATION
0 OR 0	NO REFLEX
+1 OR +	MILDLY DECREASED
+2 OR ++	NORMAL
+3 OR +++	MILDLY INCREASED
+4 OR ++++	HYPERACTIVE
+R OR R	ADDED TO GRADE IF REINFORCEMENT IS USED

D. Carotid Sinus Reflex

Action: Pressure over carotid sinus. Response: Slowing of heart rate and lowering of blood pressure.

E. Bulbocavernosus Reflex

Action: Stroking, pinching or pricking the dorsum glans penis. Response: Contraction of the bulbocavernosus muscle.

F. Bladder and Rectal Reflexes

Action: Interruption of afferent fibers. Response: Diminished urge to urinate or defecate.

Action: Interruption of efferent fibers. Response: Incontinence.

G. Mass reflex

Action: Spinal cord interruption or emotional arousal, such as fear. Response: Sudden emptying of bowel and bladder.

PATHOLOGICAL REFLEXES

Superficial or deep reflexes are normally controlled or inhibited by the motor cortex or pyramidal tracts (see Table 3). If a lower motor neuron is released from that control or inhibition by a discontinuity, certain primitive responses occur upon appropriate stimuli. These primitive responses are pathological if found in adults, but may be normal in infants up to about 6 months of age (or even up to 2 years for certain reflexes, such as Babinski's sign).

The more common pathological reflexes demonstrating upper motor neuron syndrome are anatomically grouped below:

A. Lower Extremity

1. *Ankle clonus*–Action: Forcibly and quickly dorsiflexing the foot while holding up the leg under the

TABLE 3

REFLEXES	AFFERENT NERVE	CENTER	EFFERENT NERVE
SUPERFICIAL REFLEXES			
CORNEAL	CRANIAL V	PONS	CRANIAL VII
SNEEZE	CRANIAL V	BRAIN STEM/UPPER CORD	CRANIAL V, VII, IX, X, EXPIRATION SPINAL NN.
GAG AND UVULAR	CRANIAL IX	MEDULLA	CRANIAL X
UPPER ABDOMINAL	T7-T10	T7-T10	T7-T10
LOWER ABDOMINAL	T10-T12	T10-T12	T10-T12
CREMASTERIC	FEMORAL	L1	GENITOFEMORAL
PLANTAR	TIBIAL	S1-S2	TIBIAL
ANAL	PUDENDAL	S4-S5	PUDENDAL
DEEP REFLEXES			
MAXILLARY	CRANIAL V	PONS	CRANIAL V
BICEPS	MUSCULOCUTANEOUS	C5-C6	MUSCULOCUTANEOUS
TRICEPS	RADIAL	C6-C7	RADIAL
RADIAL	C6-C8	RADIAL	
PATELLAR	FEMORAL	L2-L4	FEMORAL
ACHILLES	TIBIAL	S1-S2	TIBIAL
VISCERAL REFLEXES			
LIGHT	CRANIAL II	MIDBRAIN	CRANIAL III
ACCOMMODATION	CRANIAL II	OCCIPITAL CORTEX	CRANIAL III
CILIOSPINAL	SENSORY NERVE	T1-T2	CERVICAL SYMPATHETIC NN.
OCULOCARDIAC	CRANIAL V	MEDULLA	CRANIAL X
CAROTID SINUS	CRANIAL IX	MEDULLA	CRANIAL X
BULBOCAVERNOSUS	PUDENDAL	S2-S4	PELVIC AUTONOMIC NN.
BLADDER AND RECTAL	PUDENDAL	S2-S4	PUDENDAL AND AUTONOMIC NN.

SUMMARY OF REFLEXES. ADAPTED FROM CORRELATIVE NEUROANATOMY & FUNCTIONAL NEUROLOGY BY J. CHUSID, LANGE MEDICAL PUBLICATIONS, © 1985.

popliteal space. Response: Continued rapid flexion and extension of the foot.

2. *Babinski's sign*–Action: Stroking the plantar surface of the foot from heel to great toe, starting from the lateral side and sweeping across to the medial side at the ball of the foot. Response: Extension of the great toe.
3. *Chaddock's toe sign*–Action: Stroking the lateral malleolus. Response: Extension of the great toe.
4. *Gonda reflex*–Action: Pressing a toe down (other than the great toe) and releasing it with a snap. Response: Extension of the great toe.
5. *Gordon's leg sign*–Action: Squeezing the calf muscle. Response: Extension of the great toe.
6. *Hoover's sign*–Action: a) The hemiplegic patient is supine. b) The examiner's palms are placed under the patient's heels. c) Patient presses down. Only the non-paralyzed leg will exert pressure. d) Examiner's hand is placed on the dorsum of the non-paralyzed leg. e) Patient raises the well leg against the examiner's resisting hand. Response: a) If true hemiplegia, no additional pressure will be felt by the hand under the paralyzed leg. b) If hysterical paralysis, additional pressure will be felt as the attempt is made to raise the well leg.
7. *Huntington's sign*–Action: Supine patient coughs and strains. Response: Hip flexion, knee extension, and elevation of affected weak lower extremity.
8. *Marie-Foix retraction sign*–Action: Forcing toes downward. Response: Knee and hip flexion.
9. *Oppenheim's sign*–Action: Caudal stroking of the tibia and tibialis anterior muscle. Response: Extension of the great toe.
10. *Patellar clonus (trepidation sign)*–Action: Forcibly and quickly depressing the patella while the leg is in extension and relaxed. Response: Rapid up-and-down movement of the patella.
11. *Rossolimo's sign*–Action: Tapping the ball of the foot. Response: Flexion of the toes.
12. *Schaefer's sign*–Action: Squeezing the Achilles tendon. Response: Extension of the great toe.

B. Upper Extremity

1. *Babinski's pronation sign*–Action: Patient's supinated hands are approximated. Examiner jars the hands several times from below. Response: Affected hand falls in pronation, while the sound hand remains unaffected.
2. *Bechterew's sign*–Action: Patient flexes and relaxes both forearms. Response: Paralyzed forearm falls back more slowly and in a jerky manner.
3. *Chaddock's wrist sign*–Action: Stroking ulnar side of forearm near wrist. Response: Wrist flexion, with fanning and extension of the fingers.
4. *Gordon's finger sign*–Action: Pressure applied over the pisiform bone. Response: Extension of flexed fingers or thumb.
5. *Grasping sign*–Action: Firm, radial stroking of examiner's fingers across patient's palm. Response: Grasping reaction.

6. *Hoffman's sign*–Action: Flicking the distal phalanx of the index finger. Response: Clawing movement of the fingers and thumb.
7. *Klippel-Weil thumb sign*–Action: Examiner quickly extends flexed fingers of patient. Response: Flexion and adduction of thumb.
8. *Leri's sign*–Action: Forceful passive flexion of the wrist and fingers. Response: Absence of normal flexion of elbow.
9. *Strümpell's pronation sign*–Action: Flexing the forearm. Response: Dorsum of the hand, instead of the palm, approaches the shoulder.
10. *Trömner's sign*–Action: Sharp tapping on the palmar surface or tips of middle three fingers. Response: Finger flexion.

C. Head

1. *Babinski's platysma sign*–Action: Flexion of chin to chest or opening the mouth against resistance. Response: Platysma will contract only on the unaffected side.
2. *Head retraction reflex*–Action: Patient's head is slightly inclined forward. Upper lip is sharply percussed downward. Response: Head bending, followed by brisk head retraction.
3. *McCarthy's sign (glabella reflex)*–Action: Percussion of the supraorbital ridge. Response: Reflex contraction of orbicularis oculi muscle.
4. *Snout reflex*–Action: Sharp tapping on middle upper lip. Response: Exaggerated reflex contraction of lips.

BIBLIOGRAPHY

1. Bates B. A guide to physical examination. 3rd ed. Philadelphia: J.B. Lippincott Company, 1983
2. Chusid J. Correlative neuroanatomy and functional neurology. 19th ed. Los Altos, CA: Lange Medical Publications, 1985
3. Ferezy J. The chiropractic neurological examination. Gaithersburg, MD: Aspen Publishers, 1992
4. Mazion J. Neurological reflexes/signs/tests. 2nd ed. Orlando, FL: Daniels Publishing Company, 1980
5. Tortora G, Anagnostakos N. Principles of anatomy and physiology. 4th ed. New York: Harper & Row, 1984
6. Wyatt L. Handbook of clinical chiropractic. Gaithersburg, MD: Aspen Publishers, 1992